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(54) **CONTACT STRUCTURE FOR HIGH RELIABILITY ELECTRICAL CONNECTOR**

(71) Applicant: **Amphenol FCI Asia Pte Ltd**, Singapore (SG)

(72) Inventor: **Nickor Zuo**, Dongguan (CN)

(73) Assignee: **Amphenol FCI Asia Pte Ltd**, Singapore (SG)

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H01R 13/26 (2006.01)

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CPC ***H01R 12/721*** (2013.01); ***H01R 13/26*** (2013.01)

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CPC H01R 23/7068; H01R 23/725
USPC 439/637
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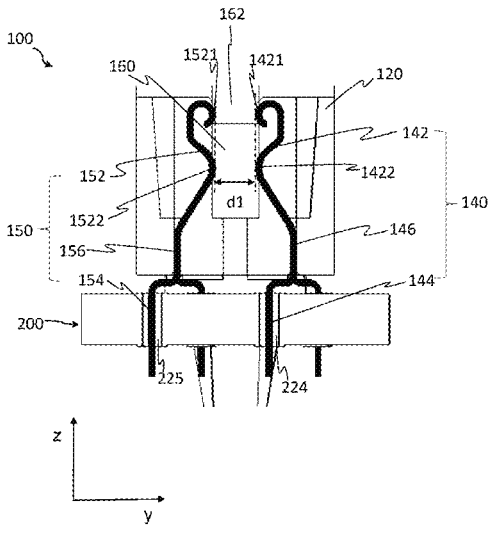
Primary Examiner — Gary Paumen
(74) *Attorney, Agent, or Firm* — Wolf, Greenfield & Sacks, P.C.

(57) **ABSTRACT**

This application relates to electrical connectors. An electrical connector, according to some embodiments, comprises a housing, a slot formed in the housing, the slot comprising an entrance, and first and second rows of conductive elements arranged in the housing. Each conductive element comprises a mounting end, a mating end opposite the mounting end, and an intermediate portion that extends between the mounting end and the mating end. The mating end comprises first and second contact portions projecting into the slot, and the first contact portion is closer to the entrance than the second contact portion. The first and second contact portions are capable of flexing along a width direction of the slot between a first position and a second position, the second contact portions form a receiving space between the first and second rows of conductive element, and the receiving space is smaller at the first position than the second position.

20 Claims, 6 Drawing Sheets



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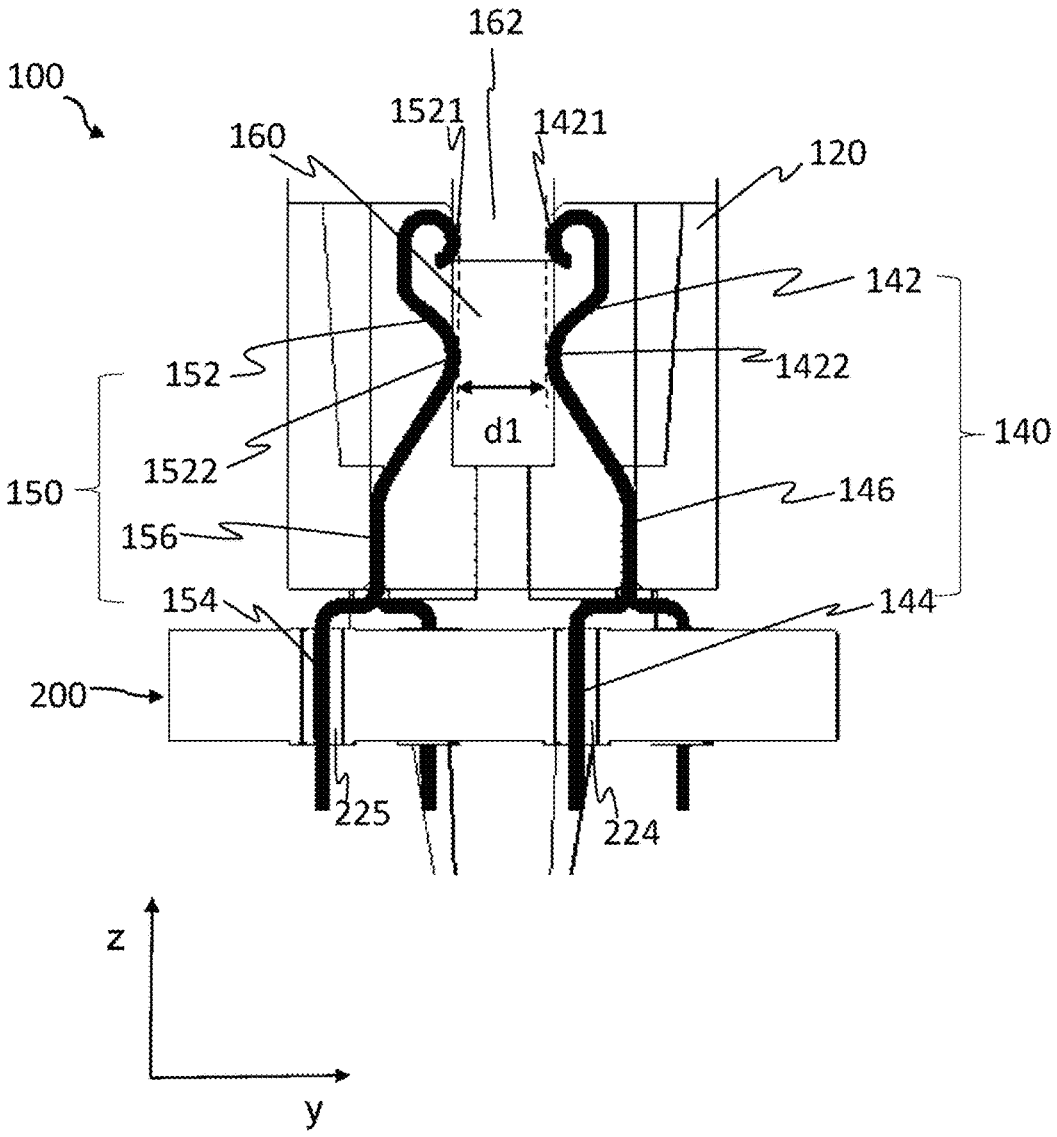
100
162
160
1521
1421
120
142
152
1422
d1
140
150
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146
156
154
144
200
225
224
z
y

FIG. 1

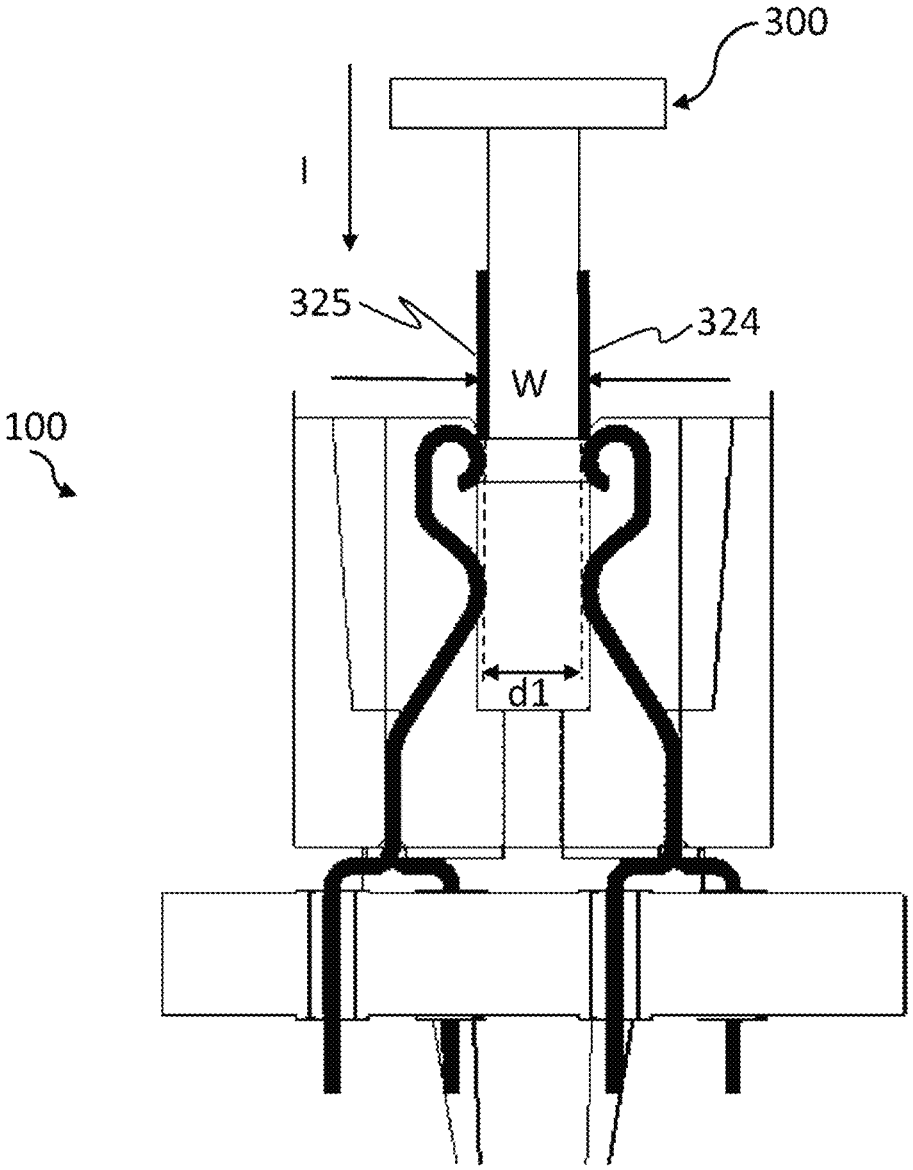

FIG. 2

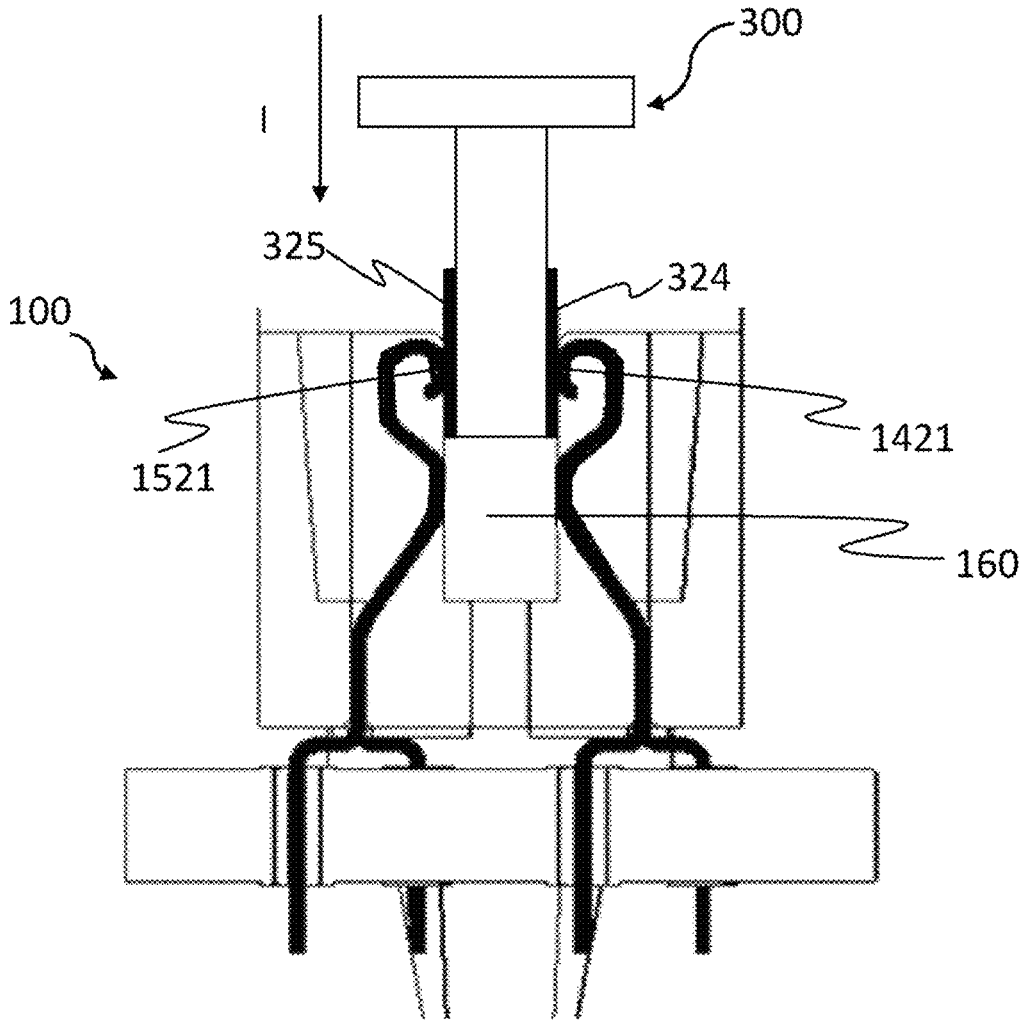

FIG. 3

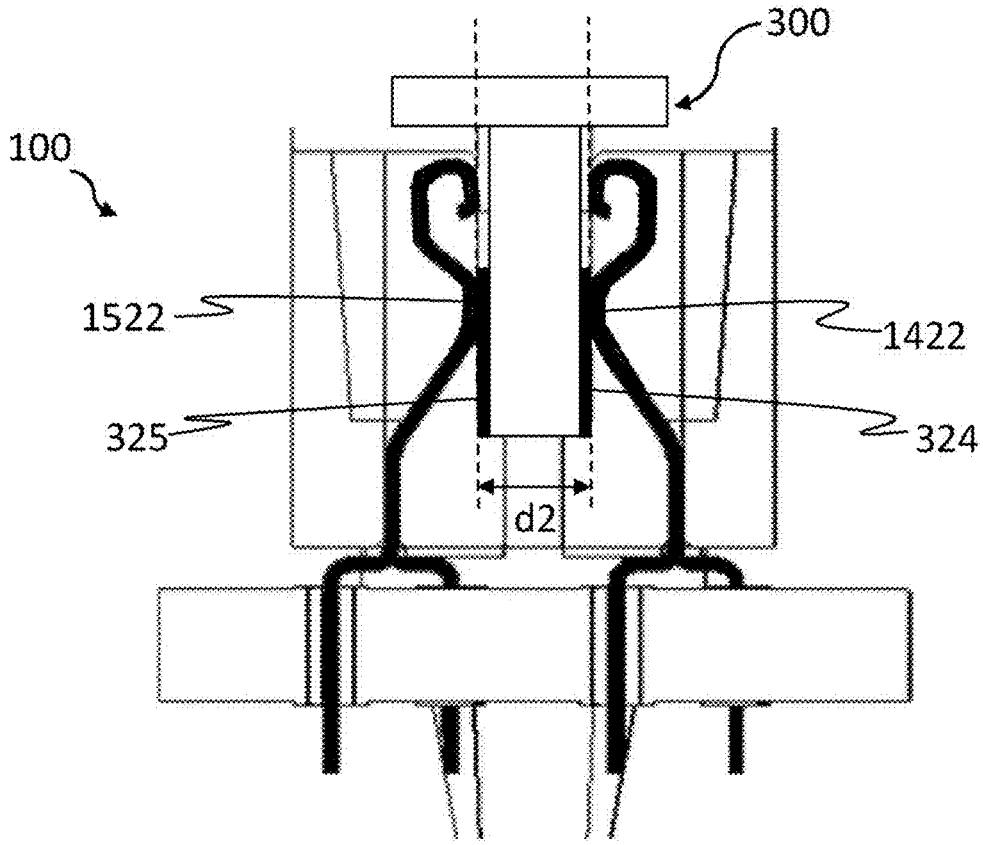

FIG. 4

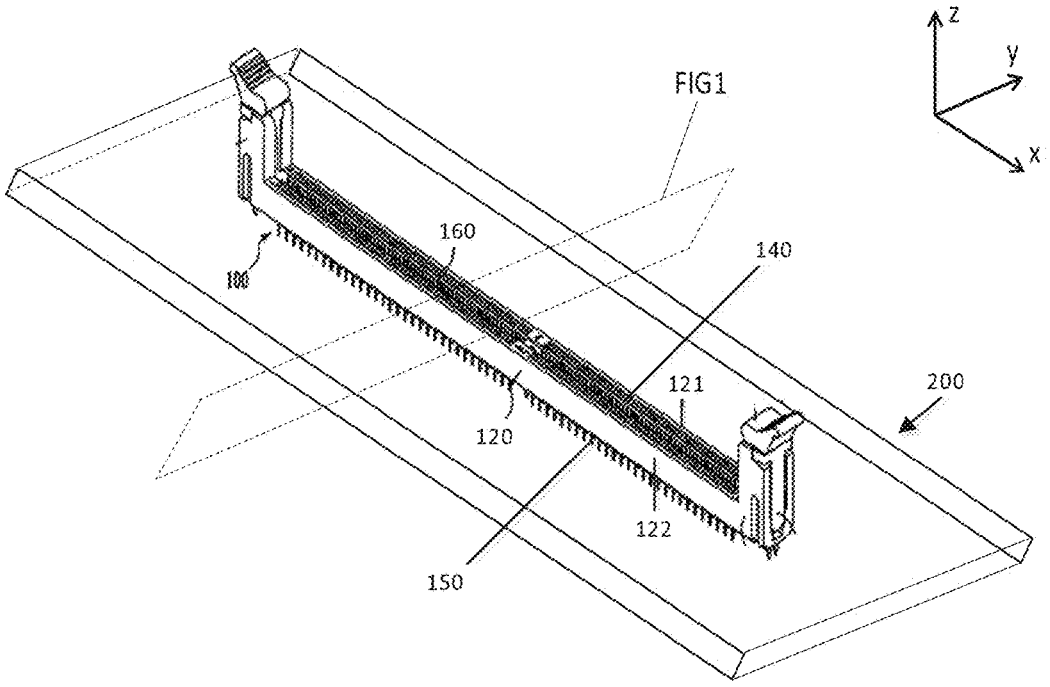

FIG. 5

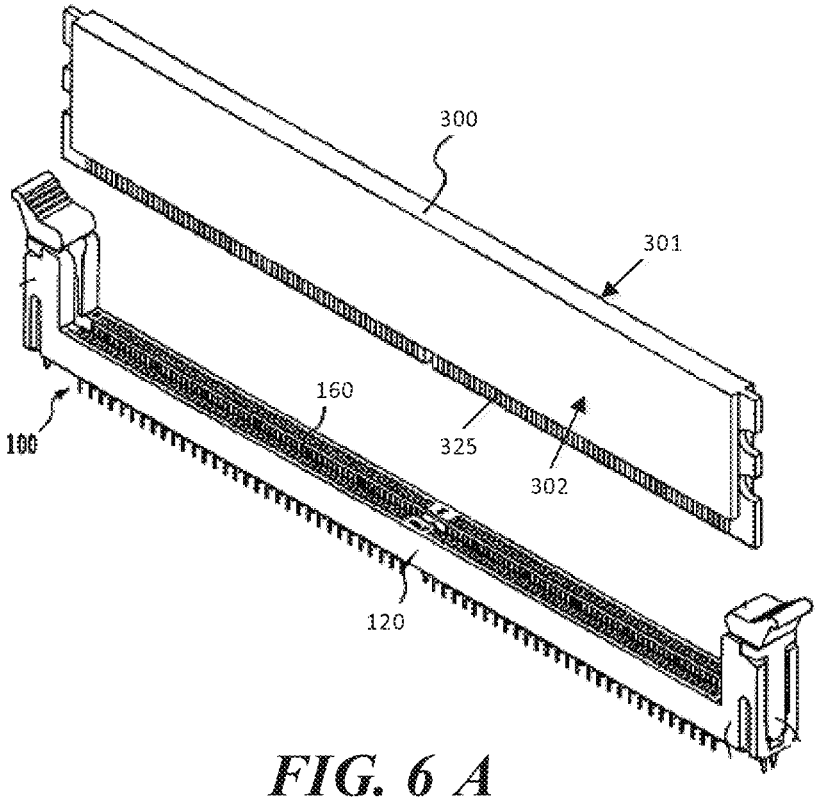

FIG. 6 A

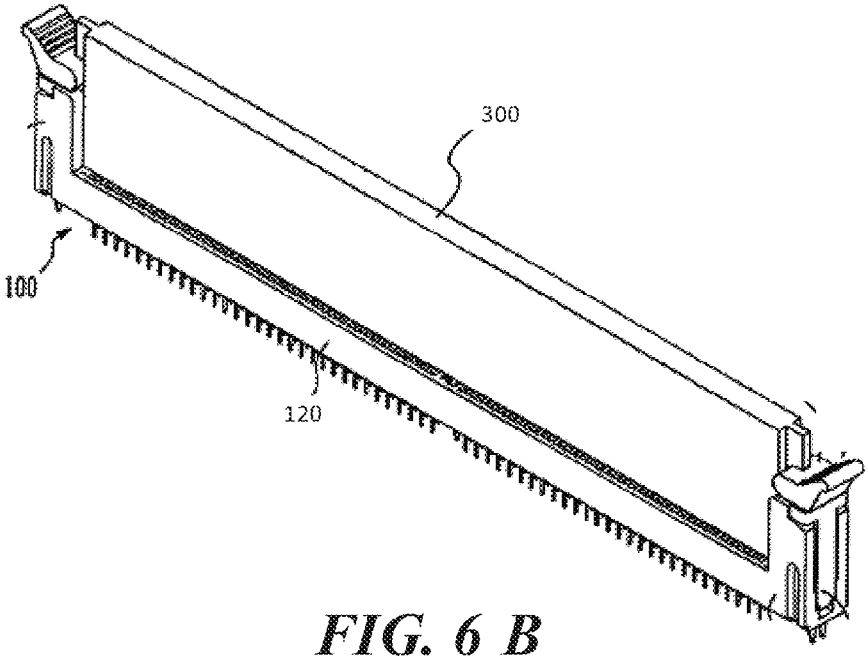

FIG. 6 B

CONTACT STRUCTURE FOR HIGH RELIABILITY ELECTRICAL CONNECTOR

RELATED APPLICATIONS

This application claims priority to and the benefit of Chinese Patent Application No. 201620277014.2, filed Apr. 6, 2016 and entitled "THE ELECTRICAL CONNECTOR," which application is hereby incorporated herein by reference in its entirety to the maximum extent allowably by law.

FIELD OF THE INVENTION

The present invention relates to an electrical connector, and more particularly to a card edge connector.

BACKGROUND

Electrical connectors are used in many electronic systems, including telecommunication, storage technology, data transmission, etc. Card edge connectors are widely used to make connections between a backplane and several daughtercards such that signals may be routed between the backplane and the daughtercards.

Card edge connectors may be mounted on a backplane. Conducting traces in the backplane may be electrically connected to conductive elements in the connectors. Daughtercards have conductive pads at edges, sometimes called contact fingers, which may be electrically connected to conductive elements of card edge connectors when inserted in slots of the card edge connectors. Signals may be routed among daughtercards through the connectors and the backplane.

Conductive pads of daughtercards are susceptible to oxidation, scratches, and/or contaminations, which may deteriorate their connections with conductive elements of card edge connectors and thus their connections with the backplane.

BRIEF SUMMARY

This application relates to electrical connectors. An electrical connector, according to some embodiments, comprises a housing, a slot formed in the housing, the slot comprising an entrance, and first and second rows of conductive elements arranged in the housing. Each conductive element comprises a mounting end, a mating end opposite the mounting end, and an intermediate portion that extends between the mounting end and the mating end. The mating end comprises first and second contact portions projecting into the slot, and the first contact portion is closer to the entrance than the second contact portion. The first and second contact portions are capable of flexing along a width direction of the slot between a first position and a second position, the second contact portions form a receiving space between the first and second rows of conductive element, and the receiving space is smaller at the first position than the second position.

The first and second contact portions may be aligned along a height direction of the slot. The first contact portion may be shaped as a hook. A proximal end of the hook may be closer to the entrance than a distal end of the hook. The second contact portion may be a curve. The apex of the curve may be closer to the slot.

BRIEF DESCRIPTION OF DRAWINGS

Embodiments of the present application will be explained in detail with respect to the drawings. In the drawings:

FIG. **1** shows a cross-sectional view of an electrical connector mounted to a printed circuit board, according to some embodiments;

FIG. **2** to FIG. **4** show cross-sectional views illustrating the process of inserting a printed circuit board into an electrical connector, according to some embodiments.

FIG. **5** is a perspective view of an electrical assembly comprising a printed circuit board, to which an electrical connector is mounted, according to some embodiments;

FIG. **6**A is a perspective view of an electrical connector before being combined with a printed circuit board;

FIG. **6**B is a perspective view of the electrical connector in FIG. **6**A after being combined with the printed circuit board in FIG. **6**A.

In the drawings, for purposes of clarity, embodiments may be simplified. Each identical or nearly identical component that is illustrated in various figures is represented by a like numeral.

DETAILED DESCRIPTION

Embodiments of the present application will be described below in detail with respect to the drawings.

FIG. **1** shows a cross-sectional view of an electrical connector **100** mounted to a printed circuit board **200**, according to some embodiments. To simplify the description, a direction parallel to a height of the electrical connector **100** is defined as z direction, and a direction parallel to a width of the electrical connector **100** is defined as y direction. FIG. **1** is a cross-sectional view along the yz plane. The electrical connector **100** may include housing **120**, conductive elements **140** and **150** arranged in the housing, and slot **160** formed in the housing. Slot **160** may receive a printed circuit board that is to be connected to the printed circuit board **200**. Slot **160** may include an entrance **162**.

In the illustrated embodiment, electrical connector **100** includes two rows of conductive elements **140**, **150**, arranged at two opposing sides of the slot **160** along a width direction (i.e. y direction as illustrated in FIG. **1**). Conductive element **140** includes a mating end **142**, a mounting end **144**, and an intermediate portion **146** that extends between the mounting end and the mating end. As illustrated in FIG. **1**, the mounting end **144** of the conductive element **140** may be press fitted into holes **224** of the printed circuit board **200**. The mating end **142** of the conductive element **140** includes a first contact portion **1421** and a second contact portion **1422**, both of which project into the lot. The first contact portion **1421** is closer to the entrance **162** of the slot than the second contact portion **1422**. The mating end **142** of the conductive element **140** may flex along the width direction and away from the conductive element **150**.

Similarly, conductive element **150** includes a mating end **152**, a mounting end **154**, and an intermediate portion **156** that extends between the mounting end and the mating end. The mounting end **154** of the conductive element **150** may be press fitted into holes **225** of the printed circuit board **200**. The mating end **152** of the conductive element **150** includes a first contact portion **1521** and a second contact portion **1522**, both of which project into the lot. The first contact portion **1521** is closer to the entrance **162** of the slot than the second contact portion **1522**. The mating end **152** of the conductive element **150** may flex along the width direction and away from the conductive element **140**. The rest states of the conductive elements **140** and **150** shown in FIG. **1** are defined as a first position, i.e. an initial position. The

distance between conductive element **140** and conductive element **150** is named as a receiving space, illustrated as d**1** in FIG. **1**.

In the illustrated embodiment, the mating end **142** and the intermediate portion **146** of the conductive element **140** and the mating end **152** and the intermediate portion **156** of the conductive element **150** symmetrically locate at the two sides of the slot **160**. In some embodiments, conductive elements **140** and **150** may be asymmetrical. The implementation of this invention is not limited by their symmetry.

In the illustrated embodiment, electrical connector **100** includes two rows of conductive elements **140**, **150**. In some embodiments, an electrical connector may have one row of conductive elements **140**. Correspondingly, the rest state of conductive elements **140** may be defined as the first position. The receiving space is the distance between conductive element **140** and an interior of a wall, which is spaced from the conductive element **140**, of the slot.

FIG. **2** to FIG. **4** show cross-sectional views illustrating the process of inserting printed circuit board **300** into electrical connector **100**. Printed circuit board **300** may include conductive pads **324** and **325** at edges of two opposing surfaces respectively. Printed circuit board **300** may be inserted into electrical connector **100** from the entrance **162** of the slot **160** along a height direction (illustrated as I), i.e. the opposite direction of z direction. Printed circuit board **300** has a thickness W, which is larger than the receiving space d**1**. Therefore, conductive elements **140** and **150** may flex away from each other under a force generated by the printed circuit board **300**.

Conductive pad **324** of printed circuit board **300** may first engage the first contact portion **1421** of the mating end **142** of the conductive element **140**. At the same time, conductive pad **325** may engage the first contact portion **1521** of the mating end **152** of the conductive element **150**. During the process of moving the printed circuit board **300** to a bottom of the slot **160**, surfaces of conductive pads **324** and **325** slide across the first contact portions **1421** of the conductive elements **140** and the first contact portions **1521** of the conductive elements **150** respectively. It should be appreciated that, under elastic forces, the mating end **142** of the conductive element **140** and the mating end **152** of the conductive element **150** may press the surfaces of the conductive pads **324** and **325**. At the same time, when the first contact portions **1421** and **1521** slide across the surfaces of the conductive pads **324** and **325**, external attachments to conductive pads **324** and **325** may be removed.

As continuing moving the printed circuit board **300** to the bottom of the slot **160**, the surface of the conductive pad **324**, which has been scribed by the mating end **142** of the conductive element **140**, may engage the second contact portion **1422** of the conductive element **140**. Similarly, the surface of the conductive pad **325**, which has been scribed by the mating end **152** of the conductive element **150**, may engage the second contact portion **1522** of the conductive element **150**. At this point, the conductive pads **324** and **325** may have cleaner surfaces in order to form reliable electrical connections with the electrical connector, which is advantageous to signal transmissions between printed circuit board **200** and printed circuit board **300**. The states of the conductive elements **140** and **150** at this point are defined as a second position. The receiving space at the second position is illustrated as d**2** in FIG. **4**. The receiving space d**1** at the first position may be smaller than the receiving space d**2** at the second position. It should be appreciated that the receiving space d**2** may be the thickness W of the printed circuit board **300**.

In the illustrated embodiment, the first contact portions and the second contact portions of conductive elements are aligned along the height direction, i.e. z direction. Correspondingly, a surface of a conductive pad of the printed circuit board **300**, which engages a second contact portion of a conductive element, has been cleaned by a first contact portion of the conductive element. The conductive elements having two contact portions provide the function of removing external attachments on conductive pads of daughtercards, and thus reliable connections between the daughtercards and the electrical connector. It optimizes signal transmissions between the daughtercards and a backplane to which the connectors mounted.

In the illustrated embodiment, the first contact portions **1421** and **1521** are shaped as a hook. A proximal end of the hook is closer to the slot **160** than a distal end of the hook. When the printed circuit board **300** engages the first contact portions **1421** and **1521**, the proximal end of the hook provides a sloped surface guiding the insertion of the printed circuit board **300**, which makes the insertion smoother. The second contact portions **1422** and **1522** may be shaped as a curve. The apex of the curve is closer to the slot **160**.

FIG. **5** shows a perspective view of an electrical assembly comprising a printed circuit board **200**, to which an electrical connector **100** is mounted, according to some embodiments. FIG. **1** may be a cross-sectional view of the electrical assembly across the marked plane FIG. **1** (i.e. a yz plane). The electrical connector **100** may include a housing **120**, and a plurality of conductive elements **140** and **150** held by the housing. The housing **120** may include a slot **160**, into which another printed circuit board may be inserted. The conductive elements **140** and **150** may be arranged into two rows at two opposing sides **121** and **122** of the slot **160** respectively.

FIGS. **6**A and **6**B illustrates perspective views of a printed circuit board **300** before and after being inserted into the slot **160** of the electrical connector **100**, according to some embodiments. The printed circuit board may include two opposing insulative surfaces **301** and **302**, at respective edges of which conductive pads **324** (not shown) and **325** may be provided. In some embodiments, the printed circuit board **300** may be a memory module. In some embodiments, the electrical connector **100** may be a DDR DIMM socket.

Although aspects of embodiments of this invention have been described with respect to the drawings, it should be appreciated that this invention is not limited by the described embodiments. It should be appreciated that various alterations, modifications, and improvements will readily occur to those skilled in the art. Such alterations, modifications, and improvements are intended to be part of this disclosure, and are intended to be within the spirit and scope of the invention.

What is claimed is:

1. An electrical connector, comprising:

a housing comprising a slot having an entrance; and

first and second conductive elements held by the housing on opposite sides of the slot, each conductive element comprising a mounting end, a mating end opposite the mounting end, and an intermediate portion that extends between the mounting end and the mating end, wherein:

the mating end comprises a single beam comprising first and second contact portions projecting into the slot such that the mating end is capable of flexing, the first contact portion being closer to the entrance than the second contact portion,

the first contact portion is shaped as a hook and comprises a proximal end and a distal end, the proximal end being closer to the entrance than the distal end, and

the first contact portion of the first conductive element is spaced from the first contact portion of the second conductive element by a distance such that the first conductive element is electrically insulated from the second conductive element.

2. The electrical connector as recited in claim **1**, wherein the slot is configured to receive a card.

3. The electrical connector as recited in claim **2**, wherein the card is a memory module.

4. The electrical connector as recited in claim **1**, wherein the second contact portion curves inwardly into the slot.

5. The electrical connector as recited in claim **1**, wherein:

the first conductive element and the second conductive element locate on opposite sides of the slot such that the mating ends of the first and second conductive elements are capable of flexing away from each other.

6. The electrical connector as recited in claim **2**, wherein:

the distance is smaller than a thickness of the card.

7. The electrical connector as recited in claim **1**, further comprising:

a first plurality of conductive elements arranged in a first row with the first conductive element; and

a second plurality of conductive elements arranged in a second row with the second conductive element.

8. An electrical assembly, comprising:

a card comprising a first insulative surface having a conductive pad thereon; and

an electrical connector, comprising a housing comprising a slot having an entrance, and a first conductive element held by the housing, the first conductive element comprising a mounting end, a mating end opposite the mounting end, and an intermediate portion that extends between the mounting end and the mating end, wherein the mating end comprises a first contact portion and a second contact portion, the first contact portion being closer to the entrance than the second contact portion; wherein:

the first contact portion of the first conductive element engages the first insulative surface and the second contact portion of the first conductive element engages the conductive pad on the first insulative surface.

9. The electrical assembly as recited in claim **8**, wherein:

the card further comprises a second insulative surface having a conductive pad thereon;

the electrical connector further comprises a second conductive element held by the housing, the second conductive element comprising a mounting end, a mating end opposite the mounting end, and an intermediate portion that extends between the mounting end and the mating end, wherein the mating end comprises a first contact portion and a second contact portion, the first contact portion being closer to the entrance than the second contact portion; and

the second contact portion of the second conductive element engages the second insulative surface and the second contact portion of the second conductive element engages the conductive pad on the second insulative surface.

10. The electrical assembly as recited in claim **8**, wherein:

the card further comprises a plurality of conductive pads on the first insulative surface;

the electrical connector further comprises a plurality of first conductive elements arranged in a row;

the first contact portions of the plurality of first conductive elements engage the first insulative surface; and

the second contact portions of the plurality of first conductive elements engage the plurality of conductive pads on the first insulative surface.

11. The electrical assembly as recited in claim **9**, wherein:

the card further comprises a plurality of conductive pads on the first insulative surface and a plurality of conductive pads on the second insulative surface;

the electrical connector further comprises a plurality of first conductive elements arranged in a first row and a plurality of second conductive elements arranged in a second row;

the first contact portions of the plurality of first conductive elements engage the first insulative surface and the second contact portions of the plurality of first conductive elements engage the plurality of conductive pads on the first insulative surface; and

the first contact portions of the plurality of second conductive elements engage the second insulative surface and the second contact portions of the plurality of second conductive elements engage the plurality of conductive pads on the second insulative surface.

12. The electrical assembly as recited in claim **8**, wherein the first contact portion of the first conductive element is shaped as a hook, and comprises a proximal end and a distal end, the proximal end being closer to the entrance than the distal end.

13. The electrical assembly as recited in claim **8**, wherein the second contact portion of the first conductive element curves inwardly towards the conductive pad on the first insulative surface.

14. A method of operating an electrical connector comprising a housing comprising a slot having an entrance, and a first conductive element held by the housing, the first conductive element comprising a mounting end, a mating end opposite the mounting end, and an intermediate portion that extends between the mounting end and the mating end, wherein the mating end comprises a first contact portion and a second contact portion, the first contact portion being closer to the entrance than the second contact portion, the method comprising:

inserting a card into the slot, wherein the card comprises a first insulative surface having a conductive pad thereon;

pressing the mating end of the first conductive element such that the mating end of the first conductive element flexes away from the slot under a force generated by the card; and

moving the card in the slot toward a direction opposite the entrance such that the first contact portion of the first conductive element engages the conductive pad on the first insulative surface of the card and then disengages the conductive pad on the first insulative surface of the card, and the second contact portion of the first conductive element engages the conductive pad on the first insulative surface of the card such that a reliable electrical connection is established between the first conductive element and the conductive pad.

15. The method as recited in claim **14**, wherein the moving step comprises removing a portion from the conductive pad.

16. The method as recited in claim **14**, wherein the moving step comprises scribing a surface of the conductive pad.

17. The method as recited in claim 14, wherein:

the card further comprises a second insulative surface having a conductive pad thereon;

the electrical connector further comprises a second conductive element held by the housing, the second conductive element comprising a mounting end, a mating end opposite the mounting end, the mating end comprising a first contact portion and a second contact portion, the first contact portion being closer to the entrance than the second contact portion, and an intermediate portion that extends between the mounting end and the mating end, wherein the first conductive element and the second conductive element are located on opposite sides of the slot;

the pressing step comprises pressing the mating end of the second conductive element such that the mating end of the second conductive element flexes away from the slot under a force generated by the card;

the moving step results that the first contact portion of the second conductive element engages the conductive pad on the second insulative surface of the card and then disengages the conductive pad on the second insulative surface of the card, and the second contact portion of the second conductive element engages the conductive pad on the second insulative surface of the card such that a reliable electrical connection is established between the second conductive element and the conductive pad on the second insulative surface of the card.

18. The method as recited in claim 14, wherein the first contact portion of the first conductive element is shaped as a hook and comprises a proximal end and a distal end, the proximal end being closer to the entrance than the distal end, the proximal end comprising a sloped surface configured to guide the card into the slot.

19. The method as recited in claim 17, wherein the first and second conductive elements space from each other by a first distance before inserting the card, and by a second distance after the second contact portions of the first and second conductive elements engaging the conductive pads on the first and second insulative surface of the card, the second distance being larger than the first distance.

20. The method as recited in claim 19, wherein the second distance substantially equals to a thickness of the card.

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